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(54) Abstract Title

Hydraulic braking system for a trailer having pressure sensing and transmission, disc brakes, and a secondary overrun brake

(57) A vehicle towing a trailer has a hydraulic braking circuit, and a sensor for hydraulic pressure or brake pedal pressure, arranged to transmit a sensor signal indicating the degree of braking required to the trailer to regulate the trailer brakes. The trailer also has a hydraulic braking system in which an electrically driven pump pressurises an accumulator and a spool valve is partially opened by an electric solenoid so trailer braking is proportional to vehicle braking. Trailer wheel speed sensors and a brake controller allow anti-lock braking (ABS) of the trailer. The brake controller opens the spool valve further upon movement in a cable-operated overrun brake used as a secondary system. The trailer is also equipped with a parking and breakaway brake.

Disc brakes are also disclosed in which a tapered brake pad 4 rotates against a spring 8 when the vehicle is reversing to release force applied on a tapered piston 1 by the secondary overrun brake. The piston has a sprung nut on a threaded shaft for automatic wear adjustment (fig. 6).

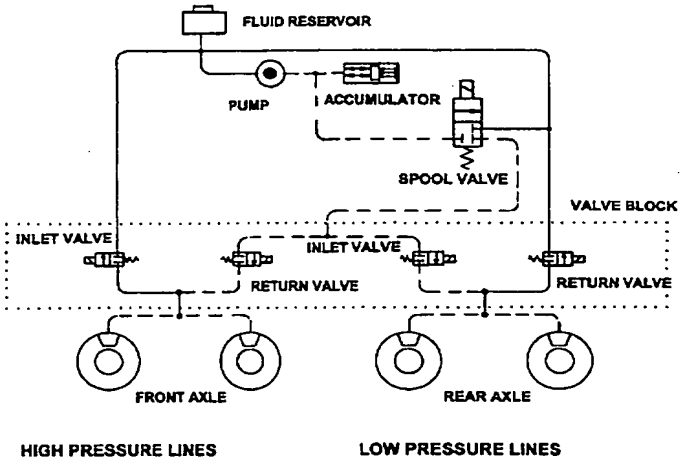

Fig. 1

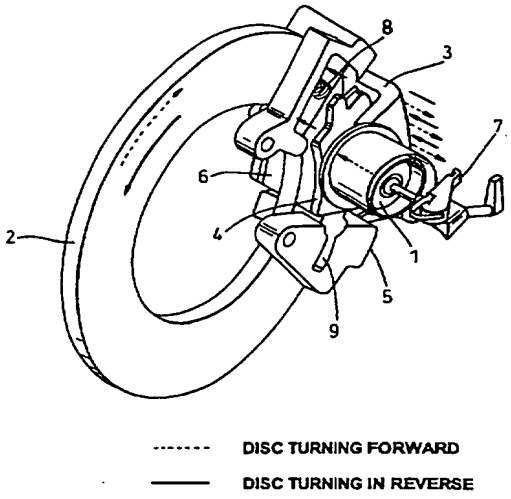

Fig. 3

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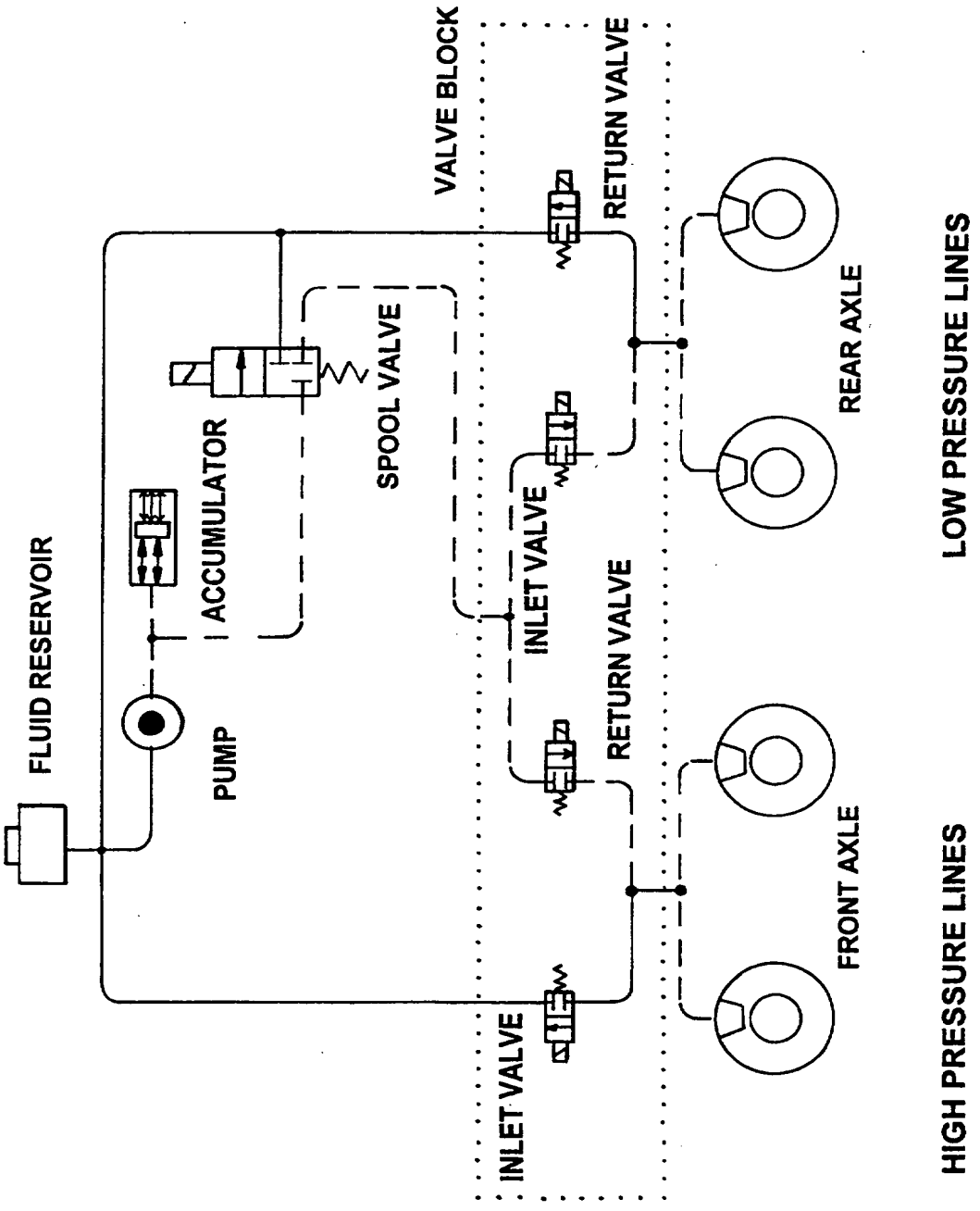

FLUID RESERVOIR
PUMP
ACCUMULATOR
SPOOL VALVE
VALVE BLOCK
INLET VALVE
RETURN VALVE
INLET VALVE
RETURN VALVE
REAR AXLE
FRONT AXLE
HIGH PRESSURE LINES
LOW PRESSURE LINES

Fig. 1

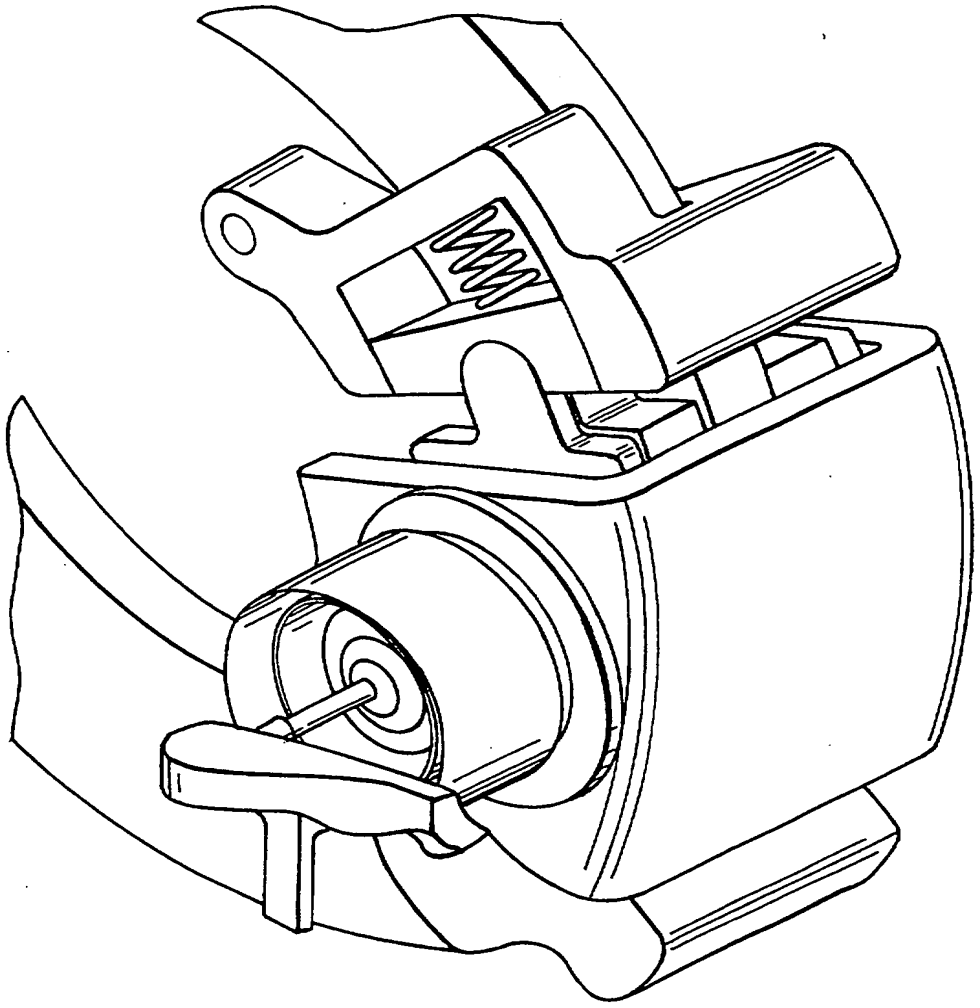
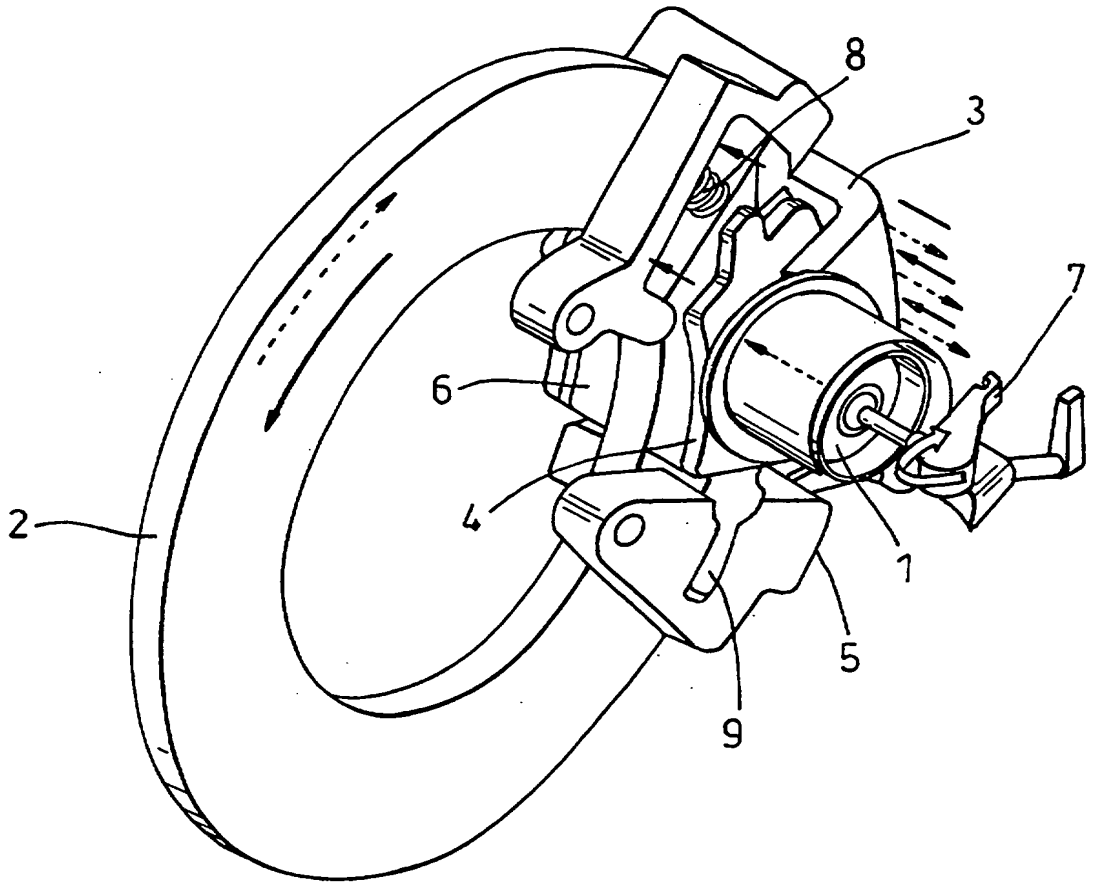


Fig. 2



------- DISC TURNING FORWARD

——— DISC TURNING IN REVERSE

Fig. 3

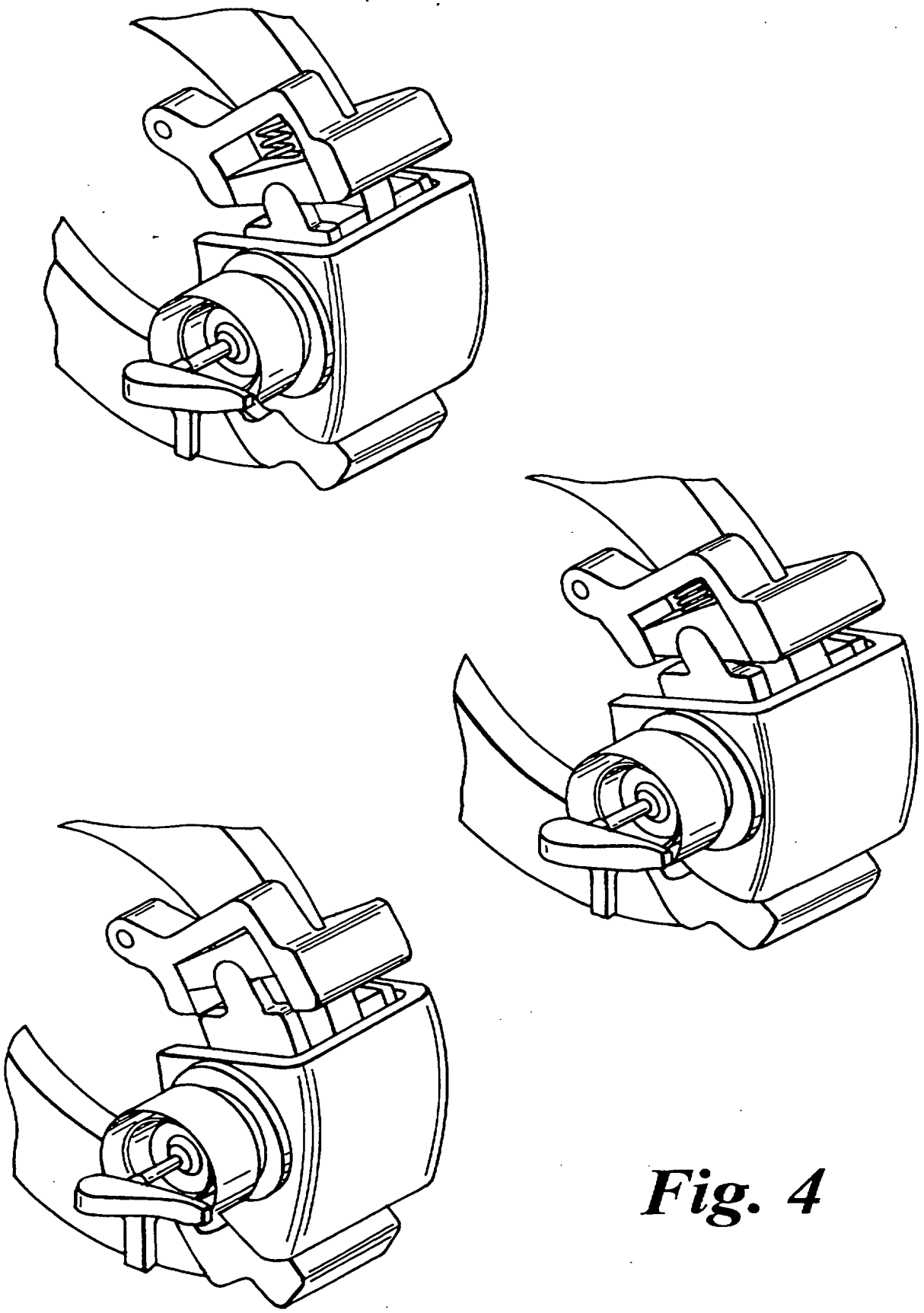


Fig. 4

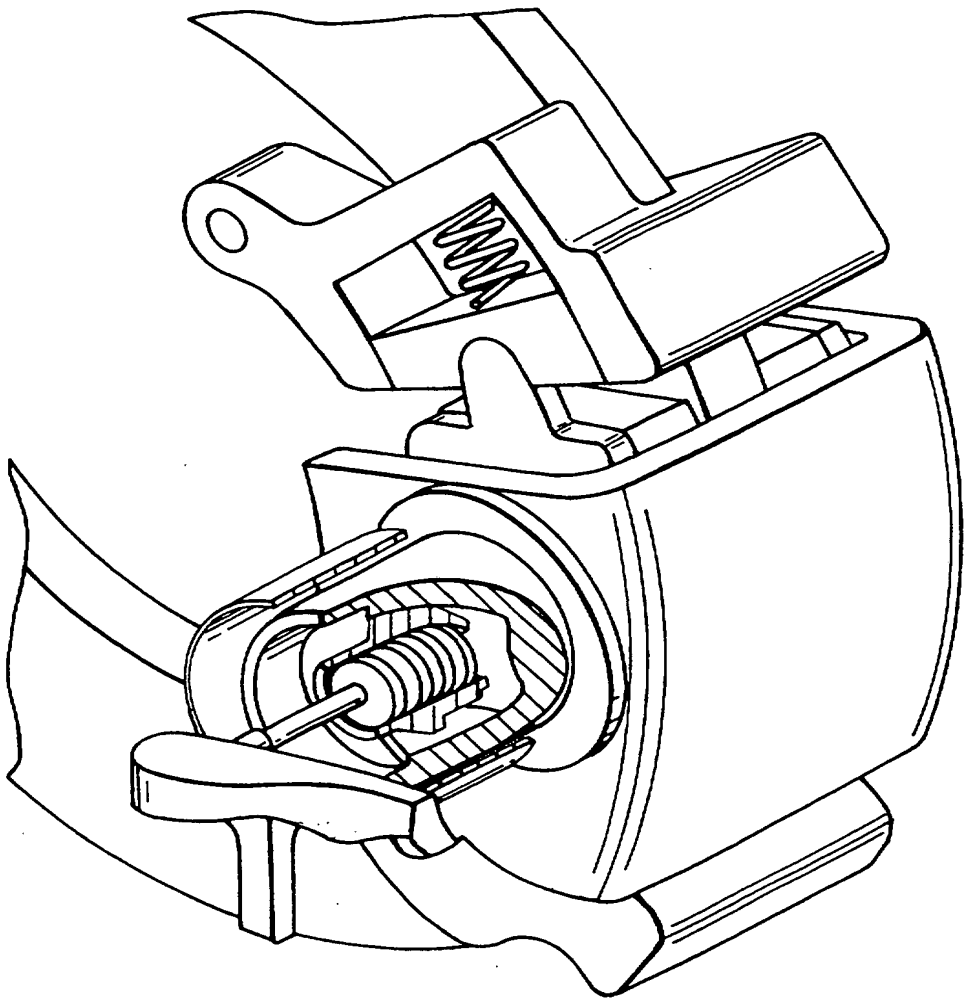


Fig. 5

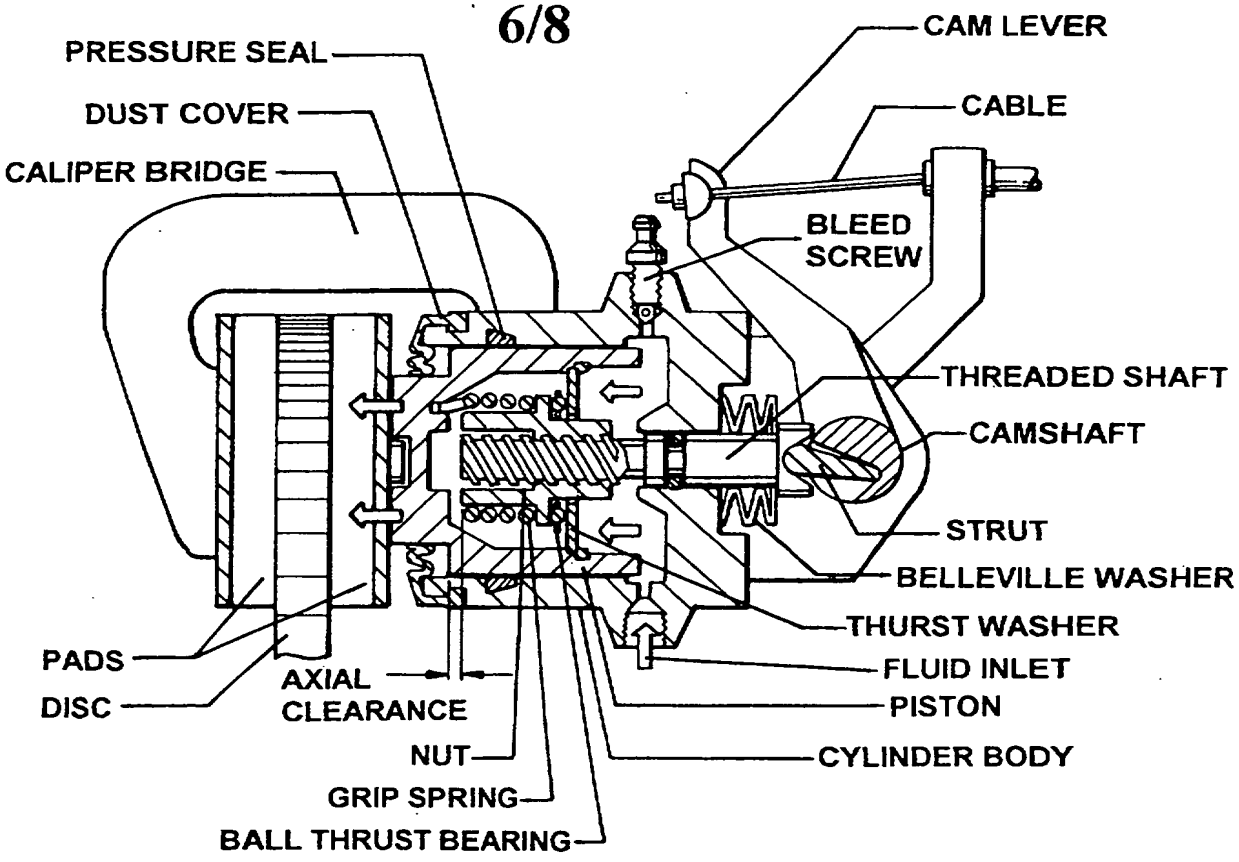


Fig. 6(a) FOOTBRAKE APPLIED

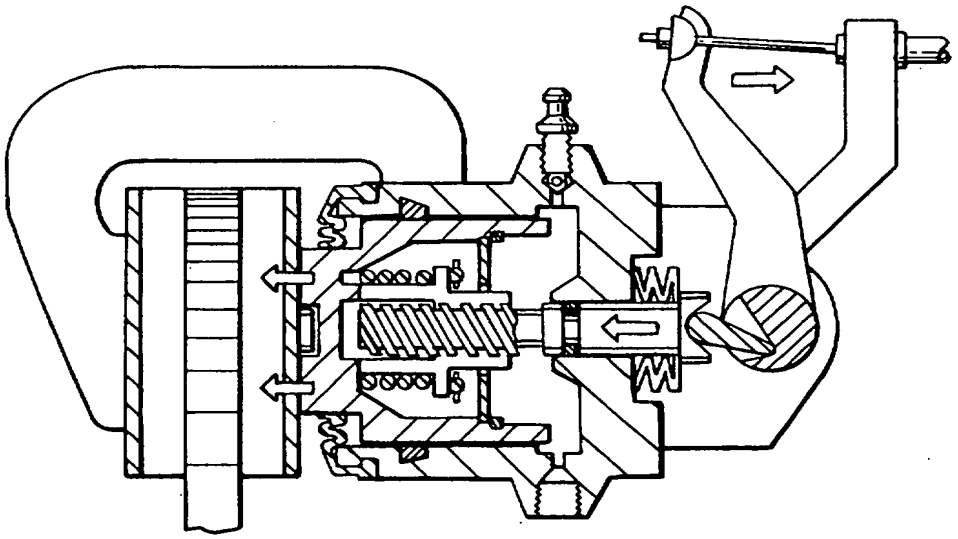


Fig. 6(b) HANDBRAKE APPLIED

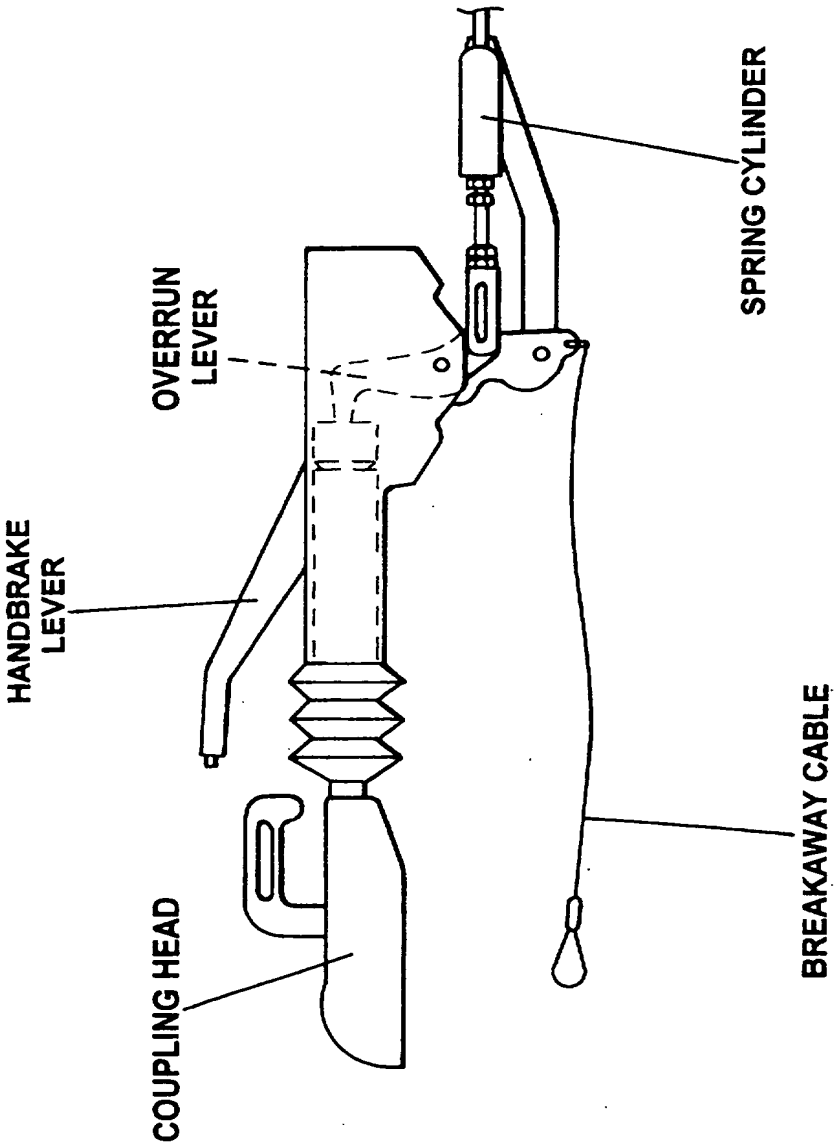

SPRING CYLINDER
OVERRUN LEVER
HANDBRAKE LEVER
BREAKAWAY CABLE
COUPLING HEAD

Fig. 7

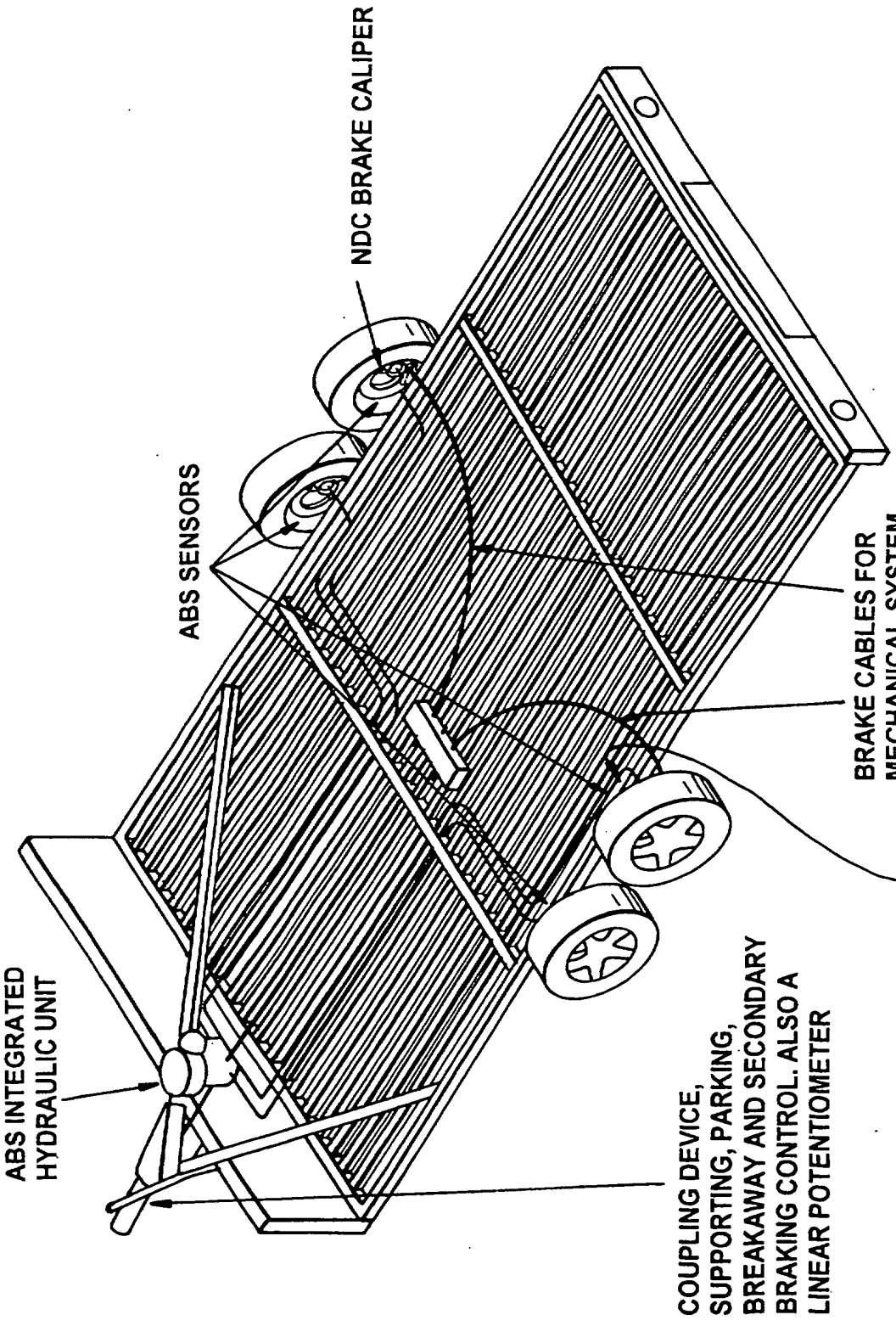

NDC BRAKE CALIPER
ABS SENSORS
BRAKE CABLES FOR MECHANICAL SYSTEM
NDC BRAKE CALIPER
ABS INTEGRATED HYDRAULIC UNIT
COUPLING DEVICE, SUPPORTING, PARKING, BREAKAWAY AND SECONDARY BRAKING CONTROL. ALSO A LINEAR POTENTIOMETER

Fig. 8

A BRAKING SYSTEM FOR A TRAILER

This invention relates to a braking system for a trailer designed and manufactured as a category 0_2 vehicle or is designed and manufactured to have a gross weight of between 750 Kg and 3500 Kg.

Category 0_2 trailers are vehicles designed to be towed by road vehicles, these trailers are designed and manufactured to have a maximum gross weight of between 750 Kg and 3500 Kg. These trailers must by law be fitted with a braking system. This braking system must:

enable the driver of the towing vehicle to operate the trailer's brakes without leaving the towing vehicle;

automatically apply the trailer's brakes should the trailer become disconnected from the towing vehicle during travel; and

incorporate a parking brake that will resist movement of trailer when applied even if the trailer is not attached to a towing vehicle (this parking brake must also be able to be operated by a person standing on the ground beside the trailer).

These trailers have a huge range of uses from the transportation of goods to mobile living accommodation known as caravans. However a presently used braking system for such trailers is a mechanical system operated by an overrun type brake controller, mechanical transmission and mechanically operated drum brakes. This current braking system provides the driver with little control over the trailer's brakes and slow reaction times for the trailer's brakes. Testing of the present system shows greatly reduced braking efficiencies of vehicles when towing trailers.

A known type of towing vehicle and trailer combination has a braking system made up of: a hydraulically operated service brake for the vehicle; a mechanically operated parking

brake for the vehicle; a mechanically operated secondary braking system on the trailer operated by an overrun brake controller; and a breakaway system operating to brake the trailer should it become disconnected from the towing vehicle. Hereafter a system of this type is referred to as being 'of the type described'.

According to a first aspect of the present invention there is provided a braking system of the type described for a towing vehicle trailer combination wherein the towing vehicle is provided with a hydraulic braking circuit incorporating a pressure sensor whereby a pressure signal relating to the degree of braking pressure applied to the hydraulic braking circuit of the vehicle is transmittable to the trailer in order to relate the degree of braking applied to brakes of wheels to the degree of braking applied to wheels on the towing vehicle.

According to a first preferred version of the first aspect of the present invention the trailer is equipped with a hydraulic braking system whose operation is regulated by the pressure sensor.

According to a second preferred version of the first aspect of the present invention or of the first preferred version thereof at least one wheel of the trailer is equipped with at least one disc brake providing for braking of the wheel. Typically in the second preferred version there are included control means whereby in the event of the or each , or each, disc brake being applied the control means is adapted to cause the, or each, disc brake to provide a braking action with the wheel or wheels rotating in a first, forward, direction and to terminate the provision of a braking action with the wheel rotating in a second, backward, direction.

According to a further version of the second preferred version the disc brake includes a brake disc adapted for rotation with an associated wheel and a brake caliper including at least one brake pad, the caliper being mounted transverse the brake disc and control

means, including piston means, the control means under braking acting to displace the, or at least one, brake pad into frictional contact with the wheel such that: with the wheel rotating in the first direction the brake pad or pads act to provide a braking action by frictional contact with the disc; and with the wheel rotating in the second direction the control system whether by function or configuration provides for frictional contact of the pad or pads and the disc to cause displacement of the pad or pads relative to the remainder of the caliper and parallel to the disc resulting in a reduction of frictional contact between pad or pads and disc by comparison with the braking action provided for with the wheel rotating in the first direction. Preferably the control means is enabled to operate by either hydraulic or mechanical actuation or both.

According to a system according to the second preferred version or the further version thereof the, or each, brake caliper includes automatic adjustment means to provide for a standard braking efficiency of the brake to be maintained regardless of the state of wear of the or each pad of the brake.

According to a third preferred version of the first aspect of the present invention or of any preceding preferred version thereof there is provided a tow bar extending from the trailer and whereby the trailer can be linked to a towing vehicle including: a rod providing a displaceable mechanical linkage to the caliper of the, or each, disc brake to provide for operation of the or each disc brake in the event that hydraulic operation ceases or the trailer becomes detached from its towing vehicle; and a spring powered means adopted, in a first configuration, to store energy for displacement of the rod and, in a second configuration, to release stored energy to cause displacement of the rod. Typically the spring powered means can be changed from its first to its second configuration by: a lever associated with the tow bar or a link attached to a towing vehicle independently of the tow bar bracket such that in the event of tow bar bracket becoming uncoupled

inadvertently, from a towing vehicle then the link serves to cause application of the trailer brake.

According to a second aspect of the present invention there is provided a trailer equipped with a braking system as according to the first aspect or any preferred version thereof for enabling it to be used with a towing vehicle.

According to a third aspect of the present invention there is provided a towing vehicle in combination with a trailer according to the second aspect .

OVERVIEW OF PROPOSED SYSTEM

The trailer braking system of the present invention can be split into two sections comprising a hydraulic system and a mechanical system.

The hydraulic system is used to operate a service brake. As the system functions in a way identical to that of a vehicle service break system it is not discussed in detail further. However a characteristic feature of the present invention is that the trailers hydraulic system is operated in close relation to the towing vehicle system and in particular that the drivers operation of the vehicle system at a particular level and rate is reflected in the consequent braking action applied to the trailer hydraulic system.

The mechanical system is used for a parking brake, secondary brake and to apply brakes on the trailer should it become disconnected from a towing vehicle.

A pressure sensor placed in a hydraulic brake line of a towing vehicle serves to trigger the hydraulic system used to apply the service brake. Once the brakes of the towing vehicle

are applied the pressure sensor will activate the braking system on the trailer to an extent proportional to the braking force applied by the towing vehicle.

The parking brake will be a mechanical system that will be applied by the operator moving a lever which in turn will mechanically operate the mechanical part of the disc brake with the use of brake rods and brake cables. The breakaway braking system will be operated by a cable connected to the towing vehicle. If the trailer should become disconnected from the towing vehicle this cable will automatically apply the mechanical part of the disc brakes with the use of brake cables and brake rods. A mechanical secondary brake will also be fitted to the trailer which will be operated with the use of a overrun type brake controller which acts to operate the mechanical part of the disc brakes with the use of brake rods and brake cables.

The actual braking will be carried out by disc brakes, but the design of disc brake is totally revolutionary and allows the vehicle to be reversed even when the overrun secondary braking system tries to mechanically operate the brakes.

An exemplary embodiment of the invention will now be described with reference to the accompanying drawings of a trailer braking system wherein:

Figure 1 is a hydraulic circuit diagram of a service brake

Figure 2 is a view of a brake caliper

Figure 3 is a sectioned view of the brake caliper of Figure 2;

Figures 4A to C show the caliper of Figure 2 and 3 in various operating positions ;

Figure 5 shows a component incorporated in the caliper of Figure 2 to 4;

Figure 6 show two views of a known adjusting brake caliper;

Figure 7 is a side view of a towing arm for use in the system incorporating a safety device; and

Figure 8 is a perspective view of a trailer incorporating the braking system.

THE TRAILER SERVICE BRAKE

Figure 1 shows a trailer hydraulic system 10 for use in operating service brakes 11 - 14 of a trailer T triggered by a pressure sensor 15 in towing vehicle brake lines 16, 17. The hydraulic system 10 is in the form of a true power brake and is self-contained within the trailer T. This system 10 has a warning signal fitted to the towing vehicle to warn a driver of the vehicle as to any faults in the braking system 10.

This type of power brake will have the ability to considerably increase the braking force, but to ensure that excessive force is not applied to the trailers brakes 11-14 n anti-lock braking system ('ABS') is fitted to avoid the possibility of wheel lock. By using ABS the trailer will not need to be fitted with any type of load sensing device.

The hydraulic power brake and the ABS unit can be totally integrated in to one system similar to that used on production cars. An electric motor is used to power hydraulic pump 18. The pump 18 serves to deliver fluid at a pressure higher than that needed by the braking system to gas charged accumulator 19. The job of the accumulator 19 is to hold the fluid under pressure until the brakes 11-14 require it. The accumulator 19 will remove any unwanted pules in the fluid pressure created by the pump 18. A non-return spool valve 20 is fitted between the pump 18 and accumulator 19 so that if the pump 18 fails there will be enough pressurised fluid to operate the brakes for a limited period. The spool valve 20 is operated by an electrical solenoid which will have the ability to partially open the valve 20 so that the trailer braking is proportional to that of the towing vehicle (i.e. the valve 20 is opened further as more braking is required). From valve 20 brake fluid will be acted directly on the wheel cylinder of brakes 11-14 unless AB S is activated. When the spool valve 20 is closed the pressure on the brakes 11-14 is released by way of

the spool valve 20 connecting the high pressure line to the wheel cylinder to low pressure line 22 so as to return the fluid to the reservoir 23.

To increase the efficiency of the system further a potentiometer will be placed on the overrun system used to operate the secondary brakes. This sensor will be used to alert the brake controller if the trailer starts to move up the rear of the towing vehicle. At no point during forward movement should the trailer move up the rear of the towing vehicle, because in this situation the brake controller will open the spool valve further, in turn increasing the braking force. Once the trailer then pulls back on the overrun system the brake controller will readjust the spool valve proportionally to the brakes being applied on the towing vehicle.

To stop the brake controller automatically applying the brakes when the vehicles is being reversed and the overrun system is depressed a pick up from the reversing lights on the towing vehicle will signal the controller not to automatically actuate the brakes.

The ABS system fitted to the trailer will have a wheel speed sensor on each wheel, however the two wheels on each axle will be regulated by the ABS as a pair. By working in this manner the risk of the brakes pulling to one side is eliminated without using a very complicated and expensive AB S.

When the ABS is not actuated the return valve in the valve block (shown in Figure. 7.) will be closed and the input valve will be open until the ABS is triggered by one of the wheel speed sensors detects the likelihood of wheel lock up. In this situation both the input and return valves on the offending axle will close holding the brake pressure in the brake caliper constant. If the wheel speed sensor still shows signs of wheel lock up, the return valve is opened and therefore allowing the brake fluid to return directly to the reservoir and in turn reducing the braking force. Once the wheel starts to accelerate again the

return valve will be closed and the input valve opened increasing the braking force once again. This chain of events will carry on until there is no risk of wheel lock up.

There are two different brake-sensing devices that can be used with the system.

The first of these is a hydraulic pressure sensor fitted in the brake line of the towing vehicle. This will be a variable pressure sensor that needs to be calibrated to the towing vehicle as different vehicles have different brake line pressure. When the driver exerts pressure on the towing vehicle's brakes this sensor will then send an electronic signal to the trailer's brake controller with information on force of braking being applied by the driver.

The second of the brake-sensing devices that can be used is pressure sensor fitted to the towing vehicles brake pedal. This will measure the physical pressure exerted on the brake pedal by the driver. This information will once again be sent to the trailers brake controller. This second type of brake sensing device may need to be used when the towing vehicle is fitted with ABS, this is due to the fact that if a brake pipe pressure sensor was fitted the towing vehicles ABS could interfere with the correct operation of the trailers ABS.

To ensure that the new trailer braking system is legal it must be fitted with both a device to automatically brake the trailer should it become disconnected from the towing vehicle and a mechanically operated parking brake. A further addition that has also be introduced is the fitting of a secondary braking system, although this is not required by law it was considered by the inventor to be absolutely necessary to ensure a safe system at all times.

The secondary braking system is operated with the use of an overrun type controller. This mechanical system should never be activated during normal use unless there is a problem with the hydraulic service brake. The overrun type brake controller will be a conventional unit as used on the vast majority of all trailers prior to the filing of this patent.

TRAILER DISC BRAKE

Disc brakes are well suited to the use on trailers as they do not tend to grab when there is only a light load on the trailer, but have the ability with a power hydraulic system to apply ample braking force when the trailer is fully loaded. Disc brakes are ideally suited toward ABS because of the controllability and quick reaction times. All of the facts mentioned above prove that disc brakes are perfectly suited towards this new design of trailer braking.

The biggest problem encountered by using disc brakes is that the overrun type secondary brake controller will try to apply the brakes when the trailer is being reversed as with the system used prior to the filing of this patent.

AUTOMATICALLY REVERSING DISC BRAKE (FIGURES 2 - 5)

In the present embodiment the hydraulic service brake 10 presents no problem when the trailer is being reversed as it is directly controlled by the driver. Consequently it is only the mechanical system that needs to be automatically released when reversing. To this end the brake assembly shown in Figure 2 has been designed to automatically release the mechanically operated part of the brakes applied by the secondary braking system when the vehicle is being reversed.

The brake assembly can be operated in one of two ways, firstly by hydraulics and secondly by a mechanical system.

When being operated by the hydraulic service brake the disc brake works in the same manner as any other sliding caliper type brake on the market. With reference to Figure 3, when the service brake is applied hydraulic pressure acts on the piston (1) this force is then transmitted through to the disc pad (4). As the pad starts applying force to the rotating disc (2) the pressure build up between the piston and caliper slides the caliper (3) on its slide pins and in turn transmits the braking force to the outbound brake pad (6). During normal braking action when the vehicle is travelling forward the disc is being turned in a clockwise direction and tends to pull the disc pad with it, however the pad is held in position by the bottom brake pad carrier (5) which resists this reaction.

A mechanical secondary braking system is operated by the overrun type controller the piston (1) is once again forced against the disc pad, only this time the force on the piston is being supplied by a brake cable which is acting on the pivot-arm (7).

When the trailer is reversed the overrun type brake controller pulls on the brake cables that again turns the pivot arm (7), which forces the piston (1) on to the brake pad, applying the brakes. However as the vehicle is now being reversed the disc tries to turn in an anti clockwise direction. As the disc pad (4) is being forced against the disc it is forced to turn in a anti clockwise direction and overcomes the spring (8) pressure holding it down onto the bottom carrier (5), therefore allowing the pad to turn. As the piston face and the back of the disc pad are cut to a taper the pressure acting between the pad and disc is released allowing the disc to turn. The action of the disc dragging the pad up and against the spring is shown in Figure 4.

Reverting to Figure 3 it will be seen that the shoe (9) of inbound disc pad has been extended. It is this extended shoe that ensures that the disc pad does not move laterally when it is lifted off the pad carrier (5) during reversing.

Once the trailer is then towed forwards the spring pushes the pad back into its natural position and normal braking will occur when required.

The brake caliper also provides an automatic adjustment to ensure that the mechanical system is always correctly adjusted and therefore keeping the braking efficiency of the secondary and parking brake standard throughout the service life of the disc pad. The adjusting mechanism is situated within the brake calliper's piston, a sectioned view of this can be seen in Figure 5.

This automatic adjustment system was developed by Bendix and is used in many production cars fitted with around disc brakes. The adjustment of the mechanical system is carried out every time the hydraulic brakes are actuated. The following passage along with Figure 6 describes how this system works.

'When the hydraulic brakes are applied, the piston outward movement is approximately equal to the predetermined clearance between the piston and nut with the brakes off, but as the pads wear, the piston takes up a new position further outwards, so that the normal piston to nut clearance is exceeded.'

If there is very little pad wear, hydraulic pressure will move the piston forward until the pad grips the disc without the thrust washer touching the ball-race. However, as the pads wear, the piston moves forward until the thrust washer contacts the ball-race. Further outward movement of the piston then forces the thrust washer, ball-race and shouldered nut together in an outward direction. Since the threaded shaft is prevented from rotating

by the strut and cam, the only way the nut can move forward is by unwinding on the screw shift. Immediately the nut attempts to turn, the coil spring uncoils d loses its grip on the nut, permitting the nut to screw out in proportion to the piston movement.

On releasing the service brake, the collapse of the hydraulic pressure enables the pressure seals to withdraw the pads from the disc.

Because the axial load has been removed from the nut, there is no tendency for it to rotate and the coil spring therefore contacts, gripping the nut so that it cannot rotate. 152

As all of the automatic adjustment of the brakes is carried out when the service brakes are actuated and not when the mechanical secondary brakes are operated the automatic adjusting mechanism will not try to over adjust the brakes when the trailer is being reversed. Unless the hydraulic service brake is applied at the same time. To eliminate the risk of this occurring the mechanical secondary brakes will only be fitted to one of the axles on a twin axle trailer. When the trailer is then reversed the ABS will close the inlet valve to that axle, therefore not enabling the hydraulic brakes on that axle to be operated. However the hydraulic service brakes will still be operational on the other axle so trailer can be braked in reverse unlike the presently used system. If the trailer only has one axle then the service brake will not operate when the trailer is being reversed, but as a singled axle trailer cannot carry great loads the towing vehicle's brakes will be more than capable of carrying out this function.

PARKING AND BREAKAWAY BRAKING SYSTEMS

Both the parking brake and the device used to apply the trailer's brakes if it should become disconnected from the towing vehicle (breakaway brake) operate the brakes via the mechanical system used by the secondary braking system.

The parking brake is operated by pulling up on the parking brake lever (Figure 7). This action then pulls on the spring cylinder, which in turn applies pressure to the brake rod.

When the trailer is parked and the parking brake is applied there must be a system to stop the brakes from automatically releasing should the trailer be parked on a reverse incline. This job is carried out by the spring cylinder connected between the brake rod and the parking brake leaver. If the brakes then start to release the spring compresses pulling the brake rod further on therefore pushing the piston within the brake caliper further in to maintain the pressure acting between the disc pad and the disc.

The breakaway cable is attached to the brake rod at the same point as the overrun type controller. If the trailer does happen to become disconnected from the towing vehicle the breakaway cable, which is attached at it's other end to the towing vehicle, is pulled forwards and in turn actuates the brake. The force acting on this breakaway cable will then snap it allowing the trailer to slowdown under its own braking.

SUMMARY OF SYSTEM

The new design of the trailer braking system shown in Figure 8 would substantially increase the safety of caravans and trailers being produced today. With use of the powered hydraulic service brake the system will not only be able to supply sufficient braking force to vastly increase the braking efficiency it will also dramatically shorten the reaction time. This reduced reaction time is very important as it will not only shorten braking distances it will also greatly aid the driver in the situation of the trailer snaking across the road. With the presently used system the only way drivers can get out of this situation safely is by very gradually decreasing their speed until eventually the trailer stops snaking. However with the new system it should be possible for the driver to apply the brake normally to recover. The reason for this is the fact that the trailer will carry out all of its own braking and not rely on that of the towing vehicle, therefore at no point will the trailer be travelling quicker than the towing vehicle and try to pass it. It is this action that causes the trailer to jack-knife or even overturn.

As the braking efficiency will be vastly increased the ABS will ensure that at no time can the wheels on the trailer lock up, whether the trailer is fully loaded or totally empty. It is this feature that will help the driver maintain control of the vehicle in bad road conditions or under emergency braking.

The design of the disc brake used will not only create a very controllable braking system but it's unique design will also allow the trailer to be automatically reversed and ensure the mechanical braking systems are always correctly adjusted to maintain a constant braking efficiency throughout the service life of the disc pads.

The mechanical secondary braking system should never be applied under normal conditions, but it has the ability to safely bring the trailer to a halt should the service brake fail. This same mechanical system is then utilised by both the parking and breakaway brakes.

CLAIMS

1 A braking system of the type described for a towing vehicle trailer combination wherein the towing vehicle is provided with a hydraulic braking circuit incorporating a pressure sensor whereby a pressure signal relating to the degree of braking pressure applied to the hydraulic braking circuit of the vehicle is transmittable to the trailer in order to relate the degree of braking applied to brakes of wheels to the degree of braking applied to wheels on the towing vehicle.

2 A braking system as claimed in Claim 1 wherein the trailer is equipped with a hydraulic braking system whose operation is regulated by the pressure sensor.

3 A braking system as claimed in any preceding claim wherein at least one wheel of the trailer is equipped with at least one disc brake providing for braking of the wheel

4 A braking system as claimed in Claim 3 including control means whereby in the event of the or each , or each, disc brake being applied the control means is adapted to cause the, or each, disc brake to provide a braking action with the wheel or wheels rotating in a first, forward, direction and to terminate the provision of a braking action with the wheel rotating in a second, backward, direction.

5 A braking system as claimed in Claim 4 wherein the disc brake includes a brake disc adapted for rotation with an associated wheel and a brake caliper including at least one brake pad, the caliper being mounted transverse the brake disc and control means, including piston means, the control means under braking acting to

displace the, or at least one, brake pad into frictional contact with the wheel such that:

with the wheel rotating in the first direction the brake pad or pads act to provide a braking action by frictional contact with the disc; and

with the wheel rotating in the second direction the control system whether by function or configuration provides for frictional contact of the pad or pads and the disc to cause displacement of the pad or pads relative to the remainder of the caliper and parallel to the disc resulting in a reduction of frictional contact between pad or pads and disc by comparison with the braking action provided for with the wheel rotating in the first direction.

6 A braking system as claimed in Claim 5 wherein the control means is enabled to operate by either hydraulic or mechanical actuation or both.

7 A braking system as claimed in Claim 5 or Claim 6 wherein the, or each, brake caliper includes automatic adjustment means to provide for a standard braking efficiency of the brake to be maintained regardless of the state of wear of the or each pad of the brake.

8 A braking system as claimed in any preceding claim wherein a tow bar bracket extending from the trailer and whereby the trailer can be linked to a towing vehicle includes:

a rod providing a displaceable mechanical linkage to the caliper of the, or each, disc brake to provide for operation of the or each disc brake in the event that hydraulic operation ceases or the trailer becomes detached from its towing vehicle; and

a spring powered means adopted, in a first configuration, to store energy for displacement of the rod and, in a second configuration, to release stored energy to cause displacement of the rod.

9 A braking system as claimed in Claim 8 wherein the spring powered means can changed from its first to its second configuration by:

a lever associated with the tow bar or

a link attached to a towing vehicle independently of the tow bar bracket such that in the event of tow bar bracket becoming uncoupled inadvertently, from a towing vehicle then the link serves to cause application of the trailer brake.

10 A braking system as claimed in any preceding claim incorporating an anti-lock braking system to resist the occurrence of wheel lock in a wheel subject to braking by the system.

11 A braking system as herein before described with reference to the accompanying drawings.

12 A trailer equipped with a braking system as claimed in any preceding claim for enabling it to be used with a towing vehicle.

13 A towing vehicle in combination with a trailer as claimed in Claim 12.

Application No: GB 0024344.4
Claims searched: 1-10,12,13

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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): F2E(ENA); F2F(FC)

Int Cl (Ed.7): B60T 7/20 13/08

Other: ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2326205 A	(STRONG), see whole document noting trailer disc brakes	3-6
X;Y	GB 1082742 A	(FERRO), see particularly page 3 lines 32-56	X:1,2,12, 13; Y:3-6
X;Y	EP 0067253 A1	(GEEST), see particularly page 2 lines 16-29	X:1,2,12, 13; Y:3-6

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.